FRD Activities Report
December 2003

Research Programs

Smart Balloon Research

GPS Receiver, Power Supply and Interface

We are continuing to adapt new GPS and satellite communication technology to improve the smart balloon instrument package. The size, weight and power requirements for GPS receivers have continued to decrease. Figure 1 shows a picture of the Lassen SQ GPS receiver manufactured by Trimble Navigation. The receiver, with attached the antenna, is the size of a postage stamp, only 1 inch on each side and 0.6 inches in height. The total weight of the receiver and antenna is 17 grams. The previous version weighed 128 grams. Power required for the new receiver is only 100 mW at 3.3 volts compared to 180 mW at 3.3 volts for the previous version.

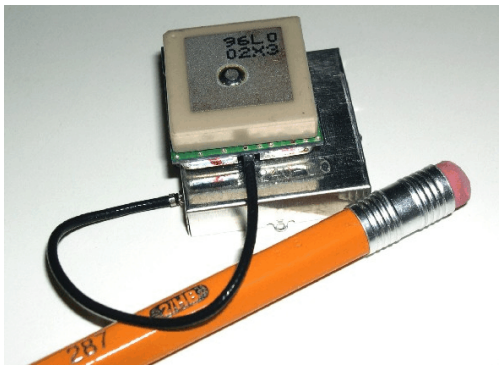

Figure 1. Lassen SQ GPS Receiver.

Figure 2 shows a picture of the GPS receiver with power supply and interface board we have designed. It is a linear regulator that provides low noise, low power and low dropout voltage power to the GPS receiver. It converts the 4.2 volts from the L-ion battery pack to the 3.0 volts required for the receiver until end of the useful life of the battery. This same board also includes translation circuitry that processes the signal from the GPS receiver to provide the necessary RS-232 interface with the transponder microprocessor.

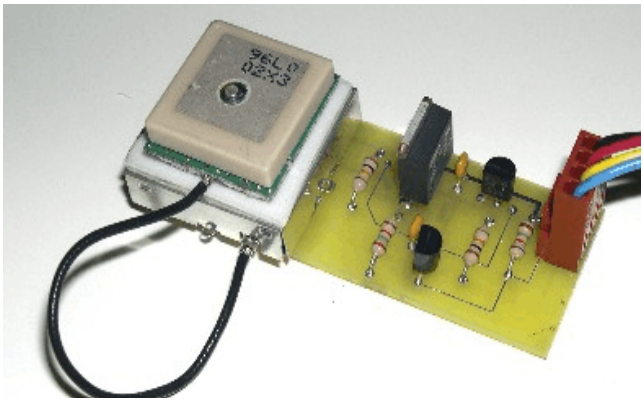

Figure 2. Lassen SQ GPS Receiver with power supply and interface board

We have tested the power supply and interface board with the GPS receiver in a new fiberglass instrument housing to ensure satisfactory operation using the RS-232 interface and a battery pack. There was no significant attenuation of the GPS signal because of the housing.

Battery Pack and Boost Power Supply

The smart balloon rechargeable battery pack is based on Sony Energytec L-ion US18650GR batteries. The voltage of the battery pack ranges from 4.2 volts when the battery pack is fully charged to 3.0 volts when discharged. All transponder subsystems require 4.4 volts or greater with the exception of the 3.3 volt GPS receiver and interface board. Voltage requirements are listed below:

Iridium Data Modem	4.4 Volts
Microprocessor	5.0 Volts
Ozone Analyzer	12.0 Volts
Valves	6.3 Volts
Temperature and RH	5.0 Volts
Barometric Pressure	5.0 Volts
Ballast Air Pump	12.0 Volts
GPS Receiver	3.0 Volts

Using a single L-ion cell simplifies battery charging and allows us to increase current capacity by adding additional cells. Batteries can be charged on the ground or while in flight using solar panels. Figure 3 shows a new, boost-type switching power supply we have designed that is 85 percent efficient. By changing one precision resistor, the output voltage of the power supply can be set to provide 4.4 to 16.5 volts at as much as a 2 ampere current. This power supply only provides boost regulation, so power for the GPS receiver is supplied by the linear regulator on the interface board.

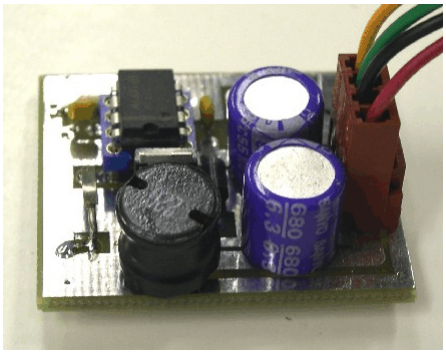

Figure 3. Boost type switching power supply.

Iridium Satellite Modem and Antenna

An Iridium satellite data modem (Figure 4), model A3LA-I, (based on the Iridium satellite phone model 9505) will be used for communication. It will provide communications over a much greater geographic area than the Globalstar satellite phone used in the previous version. The modem is intended primarily for data communications, however, it can be used for voice communications with an addition of a small voice interface box and a handset.

Figure 4. Iridium satellite phone (Model 9505)

Over 500 grams of weight are saved by removing the Iridium circuitry (Figure 5) from the factory housing. The total weight of modern electronics is 150 grams (5.3 ounces).

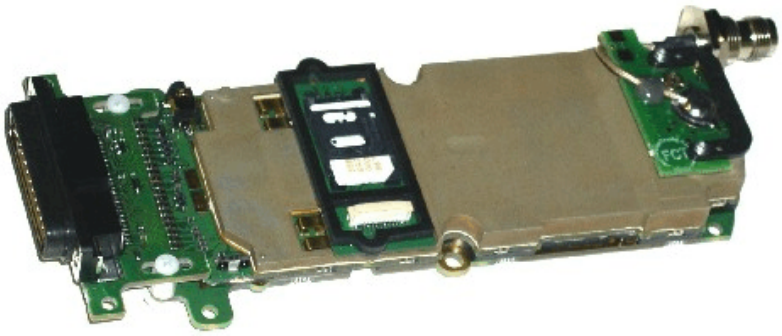

Figure 5. Circuit boards of the iridium satellite phone, removed from inside of the aluminum enclosure.

Two marine antennas (Figure 6) were purchased for operational testing with the satellite modem. We removed the antenna element and mounted it to the top plate of the transponder enclosure to reduce size and weight from 198 grams to 14 grams.

Figure 6. Marine antenna.

Figure 7. Marine antenna, after being cut open.

A series of experiments were conducted to test these modifications and isolate any possible problem or interaction between subsystems:

Experiment 1: The unmodified modem was connected to a power supply and the unmodified satellite antenna (Figure 6). Standard "AT" modem commands were used to test actual operation (call completion) and signal strength (a number from 0 to 5). The call was completed and the signal strength was 5.

Experiment 2: The electronic circuitry as shown in Figure 5 was removed from the aluminum enclosure. The call was completed and the signal strength was 5.

Experiment 3: The unmodified antenna was replaced by the stripped down version of the antenna as shown in Figure 7. The testing was repeated and the results were the same. The call was completed and the signal strength was 5.

Experiment 4: The stripped down version of the antenna and the GPS receiver and antenna were mounted side by side on the top portion of the fiberglass enclosure. The GPS engine and antenna were mounted just beneath the top plate of the fiberglass enclosure and the Iridium satellite antenna on the top side to determine if the satellite phone transmissions interfered with the operation of the GPS receiver. The call was completed and the signal strength was 5. There was some minor attenuation of the GPS signal, however, the position information was unaffected.

Fiberglass Enclosure

A new fiberglass enclosure will be used to house the instrument package. It has undergone testing and been fitted with the tubing necessary for filling and ballast adjustment. Figure 8 shows the 10 inch long tube, and Figure 9 shows the fiberglass top for the tube. Figure 10 shows it fitted with an Iridium Antenna, helium fill tube, and ballast fill tube.

Figure 8. 10" fiberglass tube.

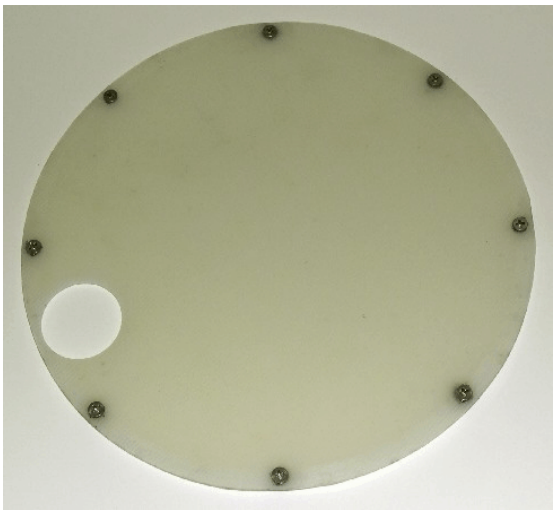

Figure 9. Fiberglass top for tube.

The .032 inch fiberglass enclosure top was fabricated using a full size template designed on Autocad and glued to .032 inch fiberglass blank (Figure 11). The top is cut out and hole centers are punched using this as a guide. There are eight #4-40 stainless steel flathead screws to center the top and keep it in position during fabrication. A two part rubber-like adhesive (ProSeal P/S 890 B-2) is used to provide a strong, flexible mechanical connection and a gas tight seal to the enclosure tube. The screws also provide significant shear strength. All of the screw holes are sealed to prevent helium leaks. (Randy.Johnson@noaa.gov)

Figure 10. Fiberglass enclosure with Iridium Antenna, helium fill tube and ballast fill tube.

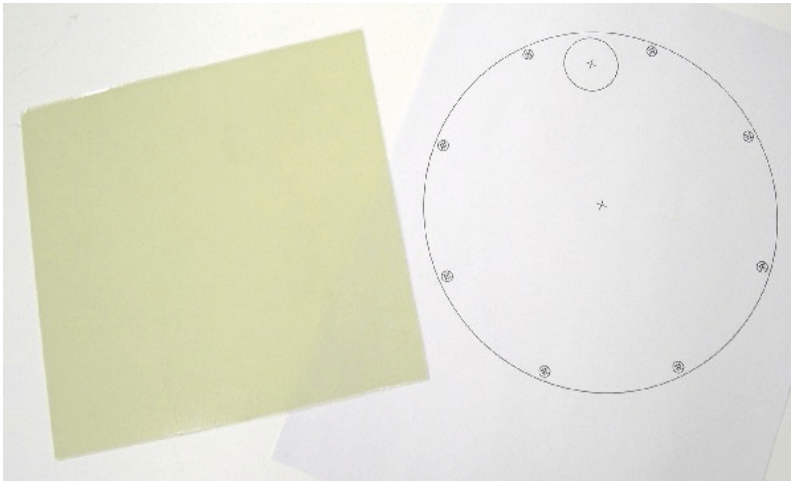

Figure 11. Template for fiberglass enclosure top.

CBLAST-Low

Work continued on the paper comparing buoy-measured winds and LongEZ-measured winds. A series of email correspondences with Jim Edson and Lara Hutto of WHOI provided us with the data report and uncorrected buoy data from the 2001 pilot study. This data is necessary for the comparisons.

Also, work on determining the wave age from the aircraft measured wave heights continued. Progess was made in determining the wave propagation direction and wave numbers. (Tami Grimmett, Jeff.French@noaa.gov)

ET Probe

An abstract on the ET probe submitted to the 26th Conference on Hurricanes and Tropical Meteorology was accepted in December. The full manuscript is due in February, and will describe progress to date on the ET probe development along with experience gained during the Hurricane Isabel deployment last September. The conference itself takes place in May 2004 in Miami. (Richard.Eckman@noaa.gov)

JOINT URBAN-2003

Review of TGA and sampler data continued during the month of December. A list of locations used for each IOP was established and cross referenced to the field sampler servicing records and final data. Since some locations were not used during some IOPs, we needed to establish which locations must have data and why some locations have missing data points. The longitude and latitudes for each sampler were reviewed and the sampling times for the SuperPIGS were

reviewed and adjusted as necessary. Final flags were determined and all the data is being combined to a final output file. Once this file is created, plots will be made to visually review the data.

A large portion of the month was spent establishing good TGA positions. Once the position data was added, software was written to combine all location data, with the appropriate flag values in the pre-determined file format. Each release for each van for each IOP was graphed and visually reviewed for anomalies. These anomalies are being reviewed in detail to determine if adjustments must be made. Quality assurance sections are being written for both the TGA and sampler data output files. (debbie@noaa.inel.gov, Roger Carter)

New York City Tracer Experiment

Planning discussions continued this month in preparation for a pilot transport and dispersion study to be conducted in New York City sometime in the summer of 2004. Preparation of an SF_6 mobile analyzer was begun so that a fugitive emissions study in New York City can be conducted next month. Additional planning meetings are on tap next month, as well. (Kirk.Clawson@noaa.gov & staff)

Cooperative Research with INEEL

INEEL Mesoscale Modeling

The new MM5 simulations initialized from the 12 km Eta model ran successfully during December on a test basis. This model configuration performs a cold start each day at 0300 UTC and then does a restart every three hours throughout the day. For both the cold start and the restarts, the model uses 4D data assimilation for both the INEEL Mesonet observations and any satellite-derived winds available within the model domain. Other sources of meteorological observations are also being considered for data assimilation. A search is also under way for better estimates of snow cover, since the snow cover included in the Eta model output is often inaccurate over Southeast Idaho. NOAA has an experimental National Snow Analysis (NSA) which appears to provide much better snow-cover estimates, but public access to these analyses is currently limited to graphical images rather than gridded files that could be ingested into a model. The documentation for the NSA states that the analyses are also available in GRIB format, but these files cannot be accessed from the NOAA web site.

Graphics based on the new MM5 simulations are being posted to a web page that is accessible within FRD but not externally. The graphics are currently fairly limited and based on NCAR Graphics, but consideration is being given to possible upgrades and an expansion of the number of products posted on the web page. A few alternate graphics packages have already been investigated, including GrADS and OpenDX. (Richard.Eckman@noaa.gov)

Other Activities

Awards

The 55th Annual Honor Awards Program was held in Washington, D. C. on December 5. Although medal winners were announced on August 8 with the presentation ceremony scheduled for September 18, the impact of Hurricane Isabel on the Washington, D. C. area made necessary the cancellation of this program, along with other government activities. Attendees at the December 5th program were still aware of the impact of weather as harsh winter conditions prevailed. At an impressive ceremony, Dr. Timothy L. Crawford was awarded a Gold Medal, the highest honorary award given by the Department of Commerce, for pioneering scientific and engineering contributions that advanced the study of airborne geosciences through small environmental research aircraft (SERA) and the BAT (Best Aircraft Turbulence) Probe. The award was accepted in his behalf by his wife, Sharon Crawford. His father, Frederick Crawford, and ARL Director, Bruce B. Hicks, also attended the ceremony. Dr. Crawford was Director of the ARL Field Research Division until his untimely death in August 2002. The Gold Medal and certificate is on display at FRD.

Safety

The safety video, “Chemical Storage Hazards” was presented at the monthly staff meeting. (debbie@noaa.inel.gov)

Travel

Tom Watson, December 8 - 12, to San Francisco for AGU Meetings, where he presented a paper and chaired two special sessions.